MAYOR AND COUNCIL WORKSESSION

NO. 4 DEPT.: DPW / T&T DATE: October 19, 2004

CONTACT: Larry Marcus, Chief of Traffic and Transportation

SUBJECT FOR DISCUSSION:

Progress update on Town Center Roadway Capacity Study.

ORDER OF DISCUSSION:

1. Summary of findings
2. Identification of impacts and challenges
3. Work schedule and next steps

GENERAL DIRECTION SOUGHT AND SPECIFIC QUESTIONS TO BE ANSWERED:

Guidance on next steps to address projected traffic congestion as outlined in the attached findings.

This is the second of three worksessions on the Town Center Roadway Capacity Study.

Worksession I 9/20/2004: Land-use scenarios
Worksession II 10/25/2004: Initial findings
Worksession III: Potential solutions

This worksession will address initial findings of the study, including projected congestion levels under three land-use scenarios. Staff will be highlighting the most congested intersections, problematic corridors, challenges and obstacles under all scenarios.

LIST OF ATTACHMENTS:

Attachment 1: Executive Summary of Findings
Attachment 2: Summary of Congestion Levels by Scenario
Attachment 3: Study Methodology

City of Rockville

MEMORANDUM

October 19, 2004

TO: Catherine Tuck Parrish, Acting City Manager

FROM: Larry Marcus, Chief, Traffic and Transportation Division LM

VIA: Eugene H. Cranor, Director of Public Works

SUBJECT: Town Center Transportation Capacity Analysis: Memorandum #1

OVERVIEW

The Traffic & Transportation Division has been asked by the Mayor and Council to assess the impact of potential redevelopment, within the Town Center, on roadway capacity. This work effort complements parallel Town Center work efforts to evaluate cut-through traffic in surrounding neighborhoods and pedestrian safety / accessibility. Two executive summaries will be produced as part of this analysis: (1) a report of congestion, delay, and travel time characteristics of existing conditions, pipeline development, and three land use scenarios; and (2) a document outlining improvements necessary to mitigate the failing (level of service F) intersections. This memorandum represents the first report, summarizing the results of the roadway capacity analysis.

Below is the project schedule for evaluating the existing and projected traffic conditions:

1. Develop Land Use Scenarios for Town Center (completed June 30, 2004)
2. Hire consultant to conduct technical traffic analysis (completed July 1, 2004)
3. Evaluate traffic congestion for various scenarios (July – September, 2004)
4. Present land use scenarios and study methodology to Mayor & Council (September 20, 2004)
5. Formulate results (October 2004)
6. Present traffic congestion levels to Mayor & Council (October 25, 2004)
7. Complete preliminary list of necessary improvements (November 2004)
8. Present list of potential improvements to Mayor & Council (November 2004)
9. Priority list of improvements identified by Mayor & Council (November – December 2004)
10. Conduct Feasibility Study (TBD)

Evaluation Methodology
The technical process was executed by BMI, Inc., a consultant to the City. The consultant followed nationally recognized best practices for evaluating traffic congestion at intersections, as defined by the Federal Highway Administration and the Institute of Transportation Engineers.

As confirmed at the September 20, 2004 worksession with the Mayor & Council and Planning Commission, the study focused on quantifying three performance measures of the roadway system: morning & evening peak hour congestion, travel time to and through the Town Center, and delay at intersections. These performance measures were developed for existing, baseline, and three Town Center land use scenarios, and focused on 25 key intersections.

This evaluation pivots from the May 2003 analysis of the Town Square development, which assessed 60 intersections in the Town Center vicinity. This study targeted 25 intersections critical to supporting future Town Center development and regional through traffic. The list of 25 intersections studied is contained in Attachment 2.

The traffic analysis evaluated the following land use scenarios: (a) existing conditions, (b) year 2006 with all approved developments, (c) three projected land use forecasts for the Town Center, assuming different magnitudes of buildout. A description of the scenarios is included in the next section of this report.

Attachment 3 represents the consultant's summary of the evaluation methodology.

Land Use Scenarios
Below is a description of the three Town Center development scenarios, as presented to the Mayor & Council on September 20. The traffic analysis added the trips generated from these scenarios to traffic representing the total demand from existing conditions, yearly regional growth, and approved developments in the Town Center.

Scenario 1:
- All currently approved pipeline projects
- Pending projects: Archstone @ First Street apartments
- Potential redevelopment: development/ redevelopment "likely scenarios" for remaining parcels. *Does not include maximum zoning potential.*

Scenario 2:
- All currently-approved pipeline projects, with potential changes to multiple-phase developments such as Rockville Center and Rockville Metro Plaza
- Pending projects: Archstone @ First Street apartments
- Potential redevelopment: development/ redevelopment "likely scenarios" of development for remaining parcels. *Does not include maximum zoning potential.*

Scenario 3:
- All currently-approved pipeline projects, with potential changes to multiple-phase developments such as Rockville Center and Rockville Metro Plaza

- Pending projects: Archstone @ First Street apartments
- Potential redevelopment: development/redevelopment for remaining parcels at maximum zoning potential.

STUDY RESULTS

The purpose of this portion of the memorandum is to identify failing intersections based on existing, baseline, and three land use scenarios for the Town Center. The following sections and Attachment 2 show intersection congestion levels. Attachment 2 also notes the critical movement(s) within each location. The critical movement identifies the "weak link" in the intersection, requiring more capacity and causing the intersection to fail. Capacity can be added by (1) simply adding a through or turning lane, (2) changing the signal timing, or (3) changing the operation of the existing roadway (such as reversible lanes, one-way streets, or parking configurations). The following sections outline the intersection congestion results, by land use scenario.

Existing Conditions

As noted in the May 2003 Town Square Study, the portals to the Town Center experience congestion, but the intersections within the Town Center (such as North Washington Street) operate quite well. Currently, two intersections of the twenty-five evaluated fail either in the morning or evening rush hour. Four other intersections operate close to or at capacity during these hours, and experience significant delays. As expected, these intersections are generally located along MD 355 and MD 28. Refer to Attachment 2 for the details of congestion levels by time of day and intersection.

Baseline Year 20 Traffic Conditions (Pipeline Development)

From a transportation planning perspective, the most important assessment of traffic capacity is reflected in the Baseline scenario. This scenario represents the existing traffic demand plus demand generated from the locally approved but unbuilt developments and regional travel. In short, this scenario represents traffic demand that can occur without further approval from a local jurisdiction. Further, the scenario contains programmed capacity improvements for this timeframe, including Maryland Avenue extended to Dawson, Renaissance Street, and the extension of Fleet Street.

As expected, arterial portals to the Town Center will continue to be stressed by the growth in trips not destined for the Town Center. As shown in Attachment 2, congestion along MD 355 and MD 28 increases significantly, even with the programmed improvements associated with the already approved developments. This creates quite a challenge, as the portals accessing the Town Center experience delays, while the Town Center core streets continue to operate well. Note that Maryland Avenue continues to operate at an acceptable level of service from I-270 to MD 28.

Land Use Scenarios 1-3

The scenarios add 5,150-8,030 peak hour trips to the system, and do not contain any additional roadway capacity improvements – as none exist in the master plan for this vicinity. The Maryland State Highway Administration (MD SHA) is formally studying three intersections in the study area, and have been asked to evaluate the impact of adding an interchange at I-270 /

Gude Drive and MD 355 / Gude Drive. The next memorandum will include the traffic relief absorbed by the construction of (1) the Gude interchanges, (2) the InterCounty Connector, and (3) a four lane Wootton Parkway. Of these three packages of improvements, the InterCounty Connector is the only project proposed for funding by MD SHA. The interchanges on Gude Drive are shown in the City's Master Plan.

As expected, the three scenarios overwhelm the existing configurations of MD 355 and MD 28. Intersections in the southern portion of the Town Center, from Middle Lane to the Wootton Parkway corridor, are also projected exceed capacity. In summary, 18 of 25 intersections would operate at level of service (LOS) "F" in Scenario 3, while in Scenarios 1 and 2, 17 of 25 intersections will operate at LOS "F". Specific intersection congestion levels, with critical movements, are detailed in tabular form and on maps in Attachment 2.

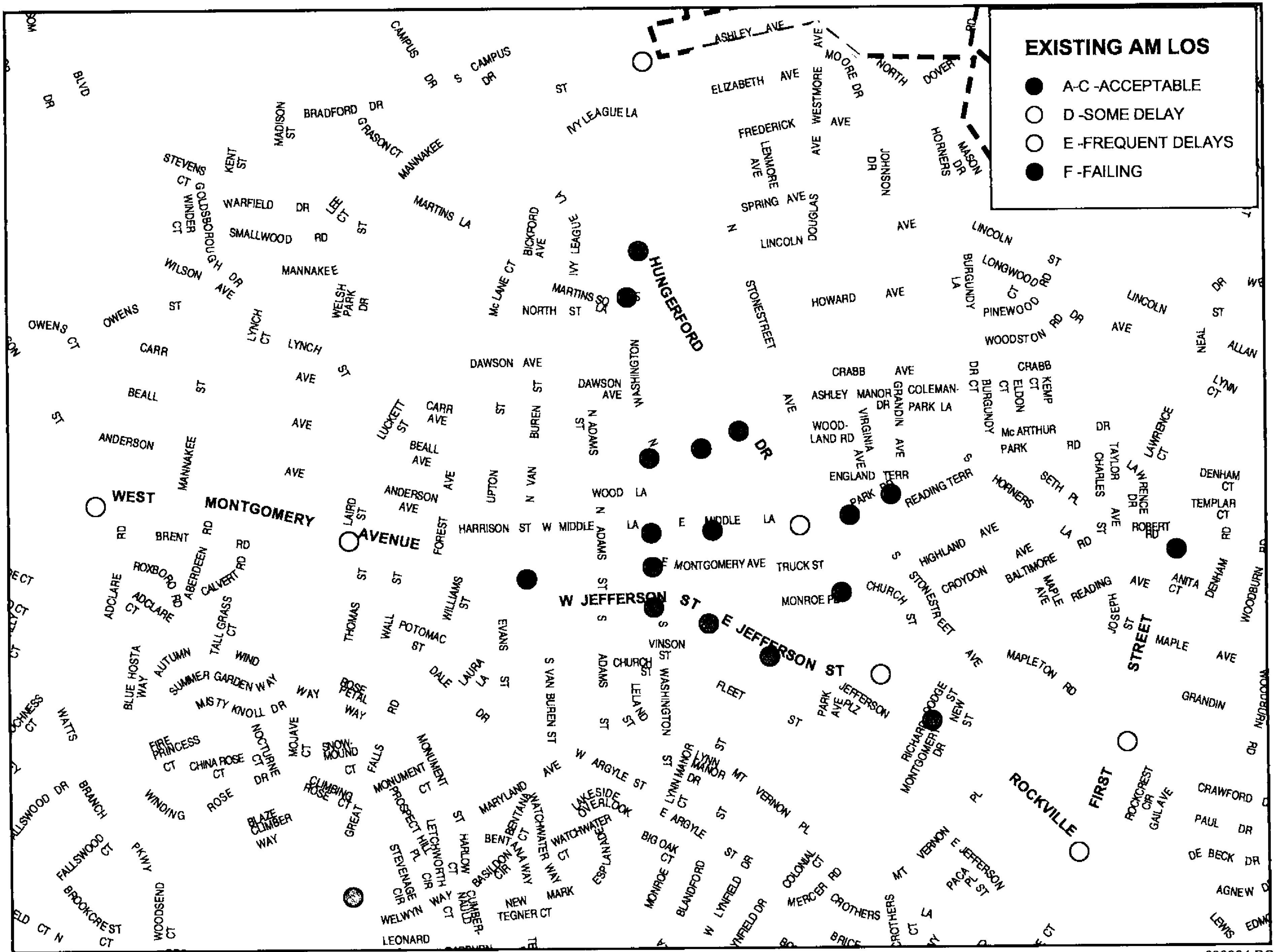
Travel time and delay information will be presented at the October 25 worksession, using travel simulation tools.

NEXT STEPS

City staff identified four main goals in mitigating the additional traffic generated from the Town Center redevelopment: (1) when possible, add intersection capacity to maintain acceptable intersection congestion levels as defined in the Comprehensive Transportation Review, (2) if a failing intersection is close to the Metrorail station or provides a critical pedestrian link, substitute intersection traffic improvements with multi-modal improvements, (3) do not move any curbs in residential areas, unless it enhances pedestrian accessibility / safety, (4) minimize the impacts on the surrounding communities.

With these four goals in mind, City staff proposes the following steps to identify feasible roadway capacity improvements. Each step would include guidance from the Mayor & Council, Planning Commission, and Traffic & Transportation Commission:

(1) Identify all potential roadway capacity improvements to technically address the capacity deficiencies.
(2) Present the list of potential roadway improvements to the three review bodies for guidance on feasibility and community impacts.
(3) Determine a list of acceptable roadway capacity improvements (if any), as defined by the Mayor & Council.
(4) Devise a balanced Town Center redevelopment plan with associated transportation capacity improvements.


EXISTING AM LOS
A-C -ACCEPTABLE
D -SOME DELAY
E -FREQUENT DELAYS
F -FAILING
WEST MONTGOMERY AVENUE
HUNGERFORD DR
W JEFFERSON ST
E JEFFERSON ST
ROCKVILLE
FIRST STREET

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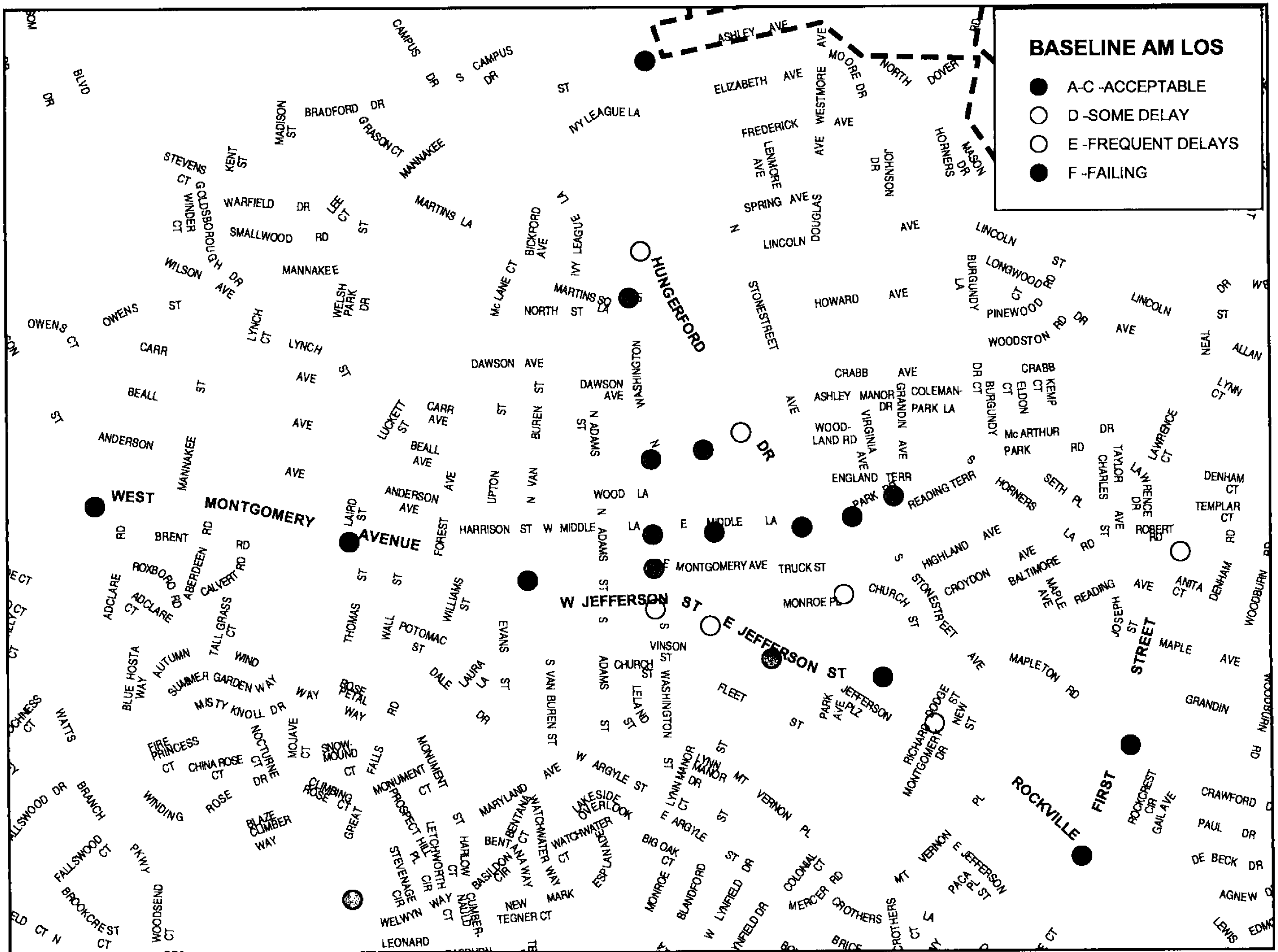

*future street alignments in darker shade

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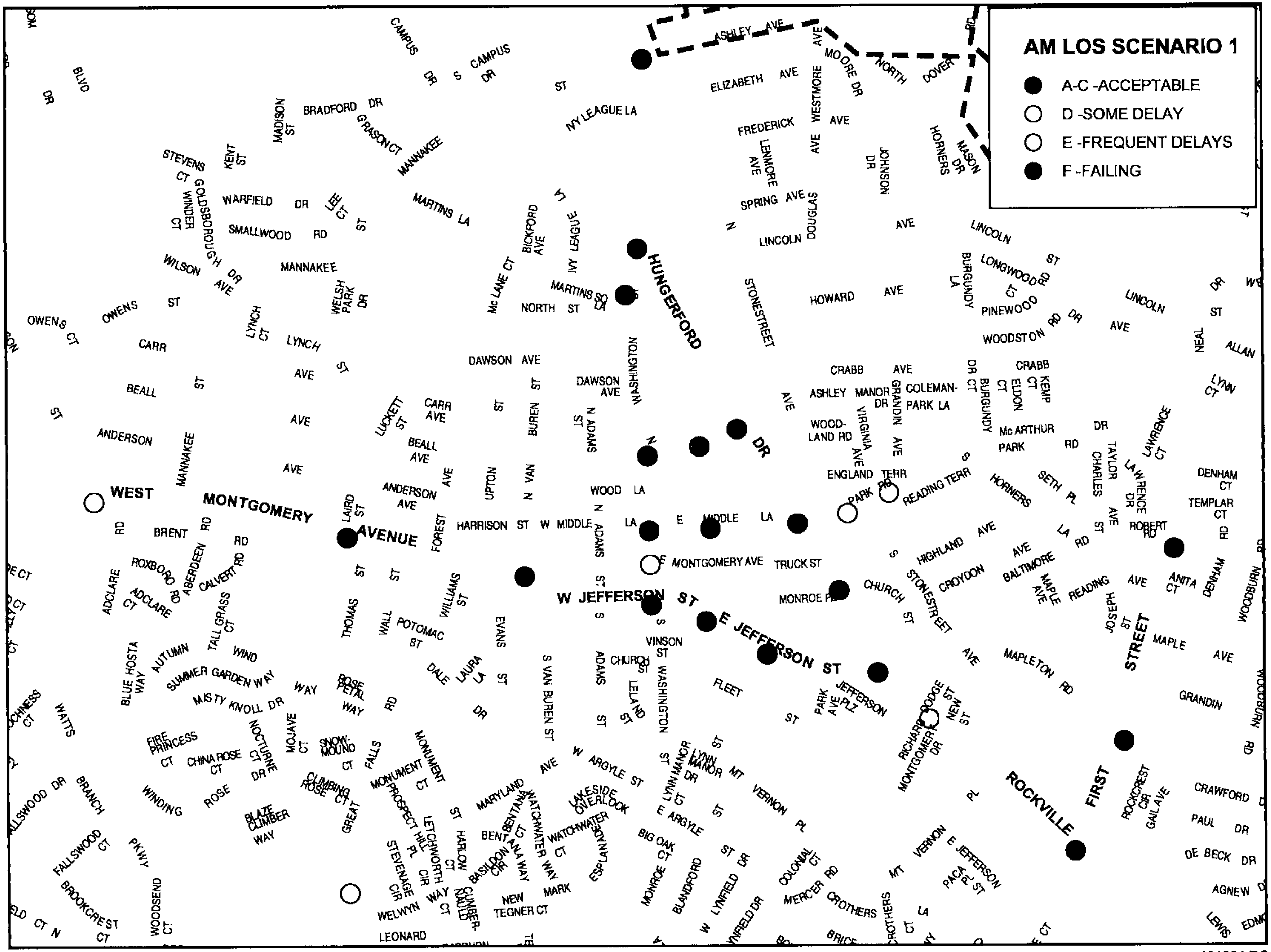

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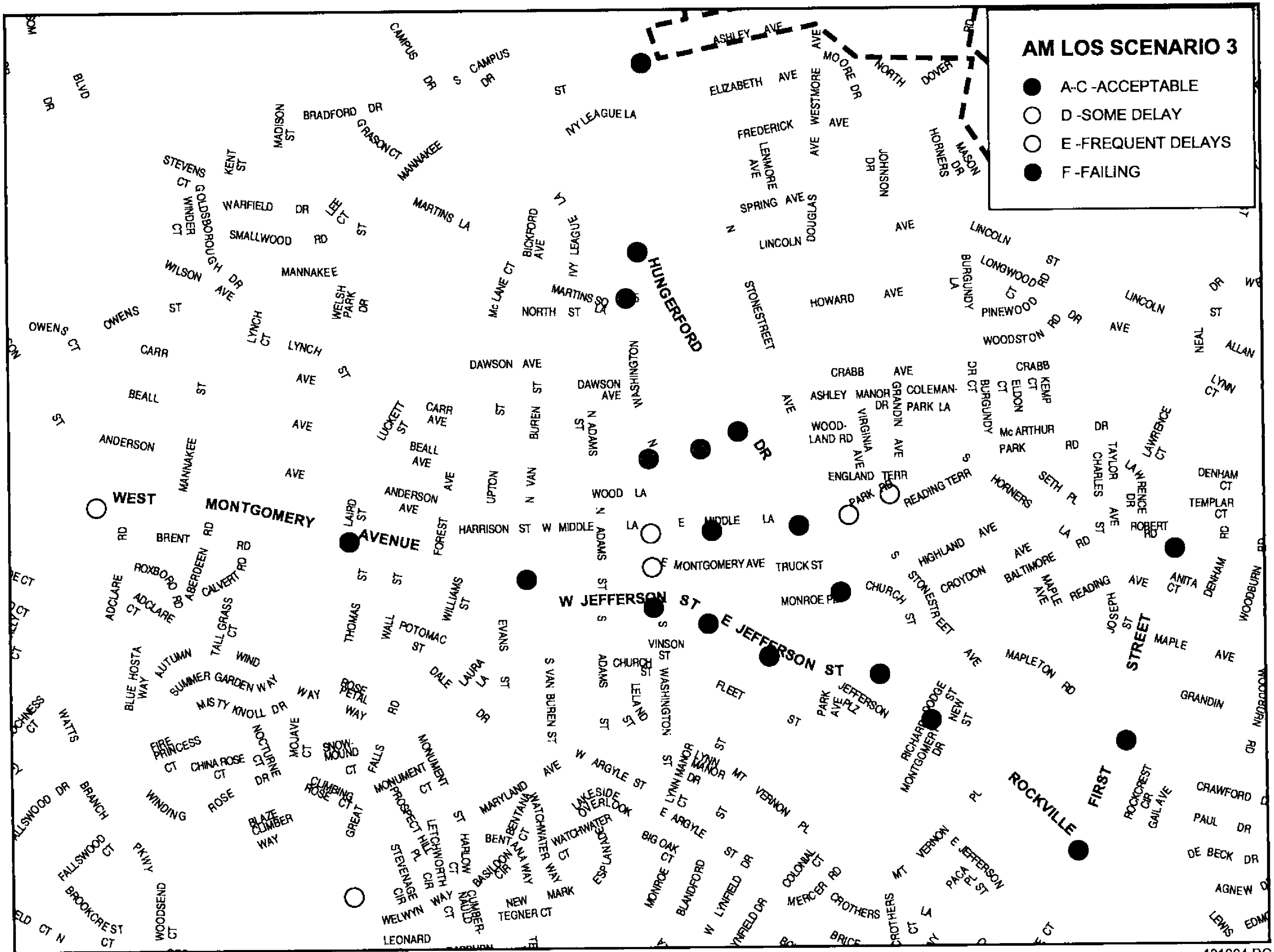

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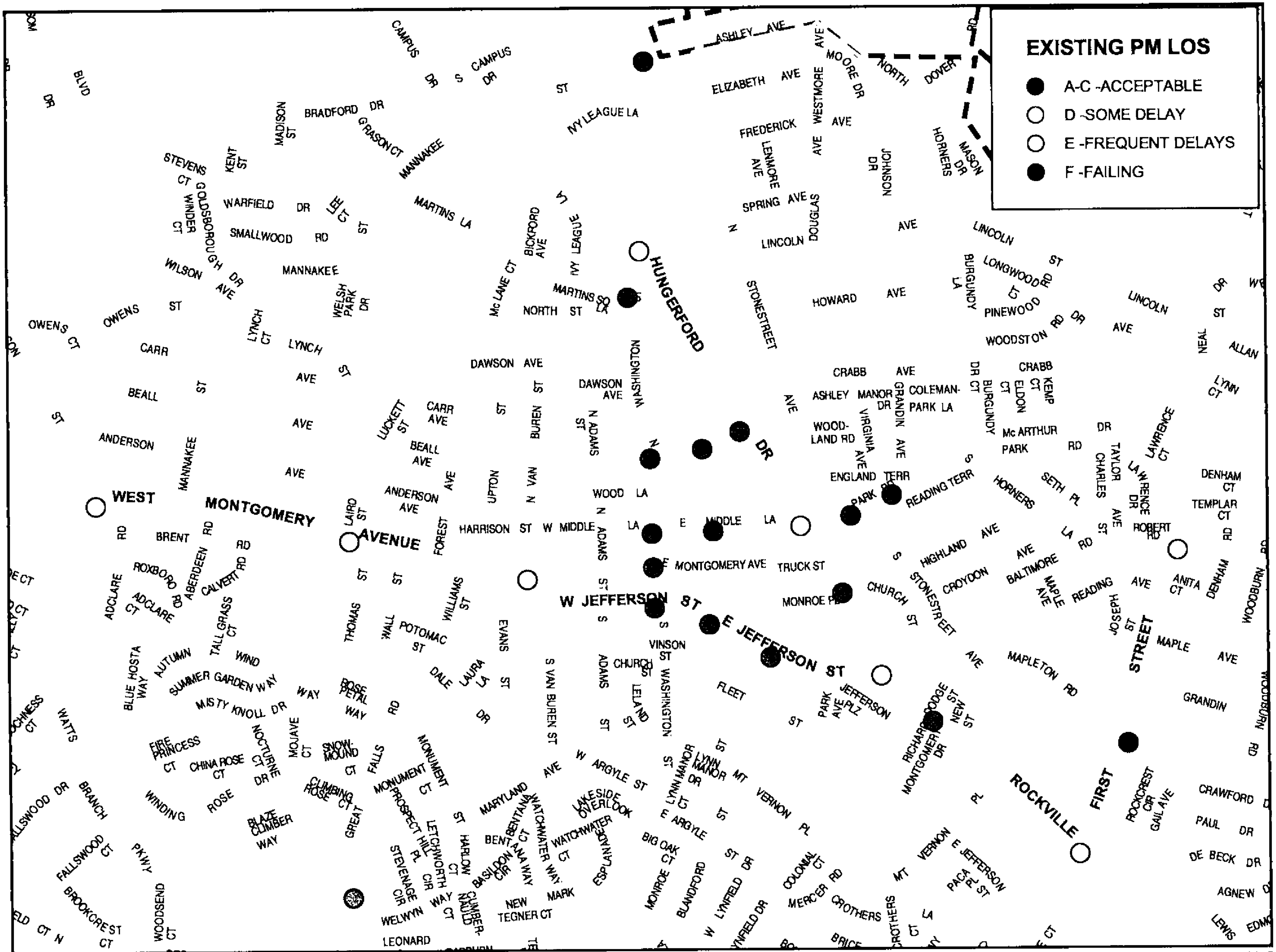
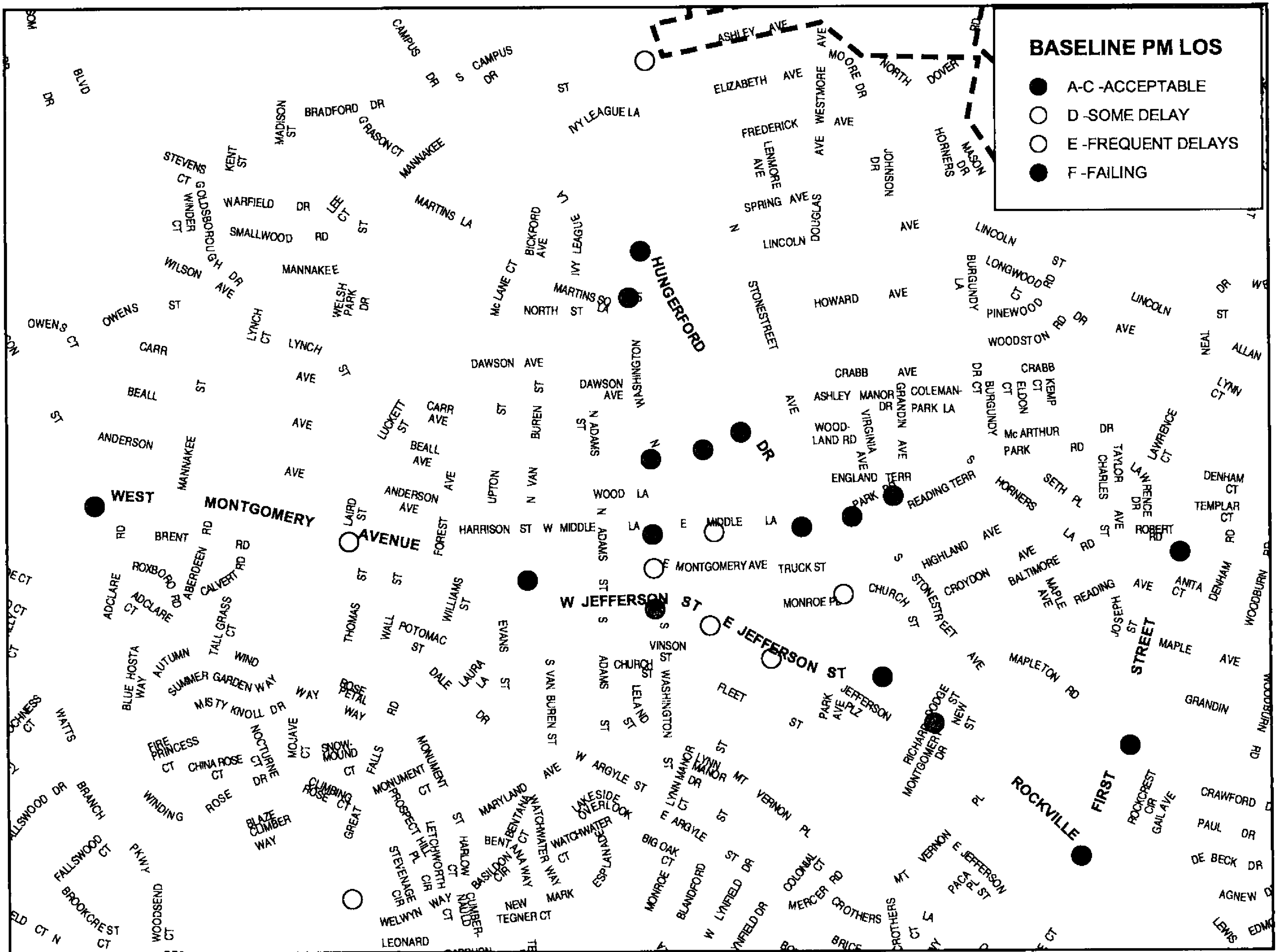

EXISTING PM LOS
A-C -ACCEPTABLE
D -SOME DELAY
E -FREQUENT DELAYS
F -FAILING
WEST MONTGOMERY AVENUE
HUNGERFORD DR
W JEFFERSON ST
E JEFFERSON ST
ROCKVILLE
FIRST STREET
090804 RC



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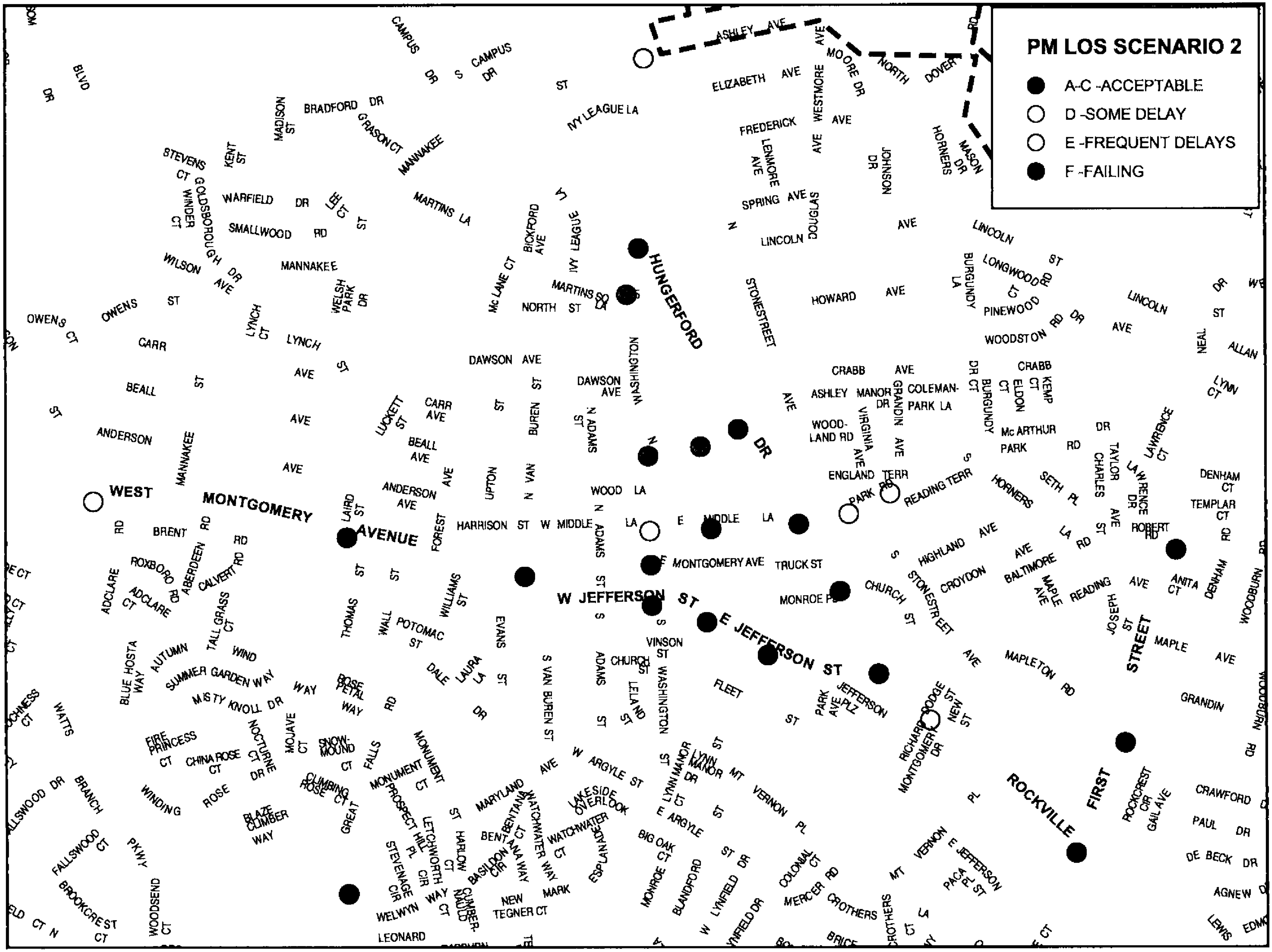

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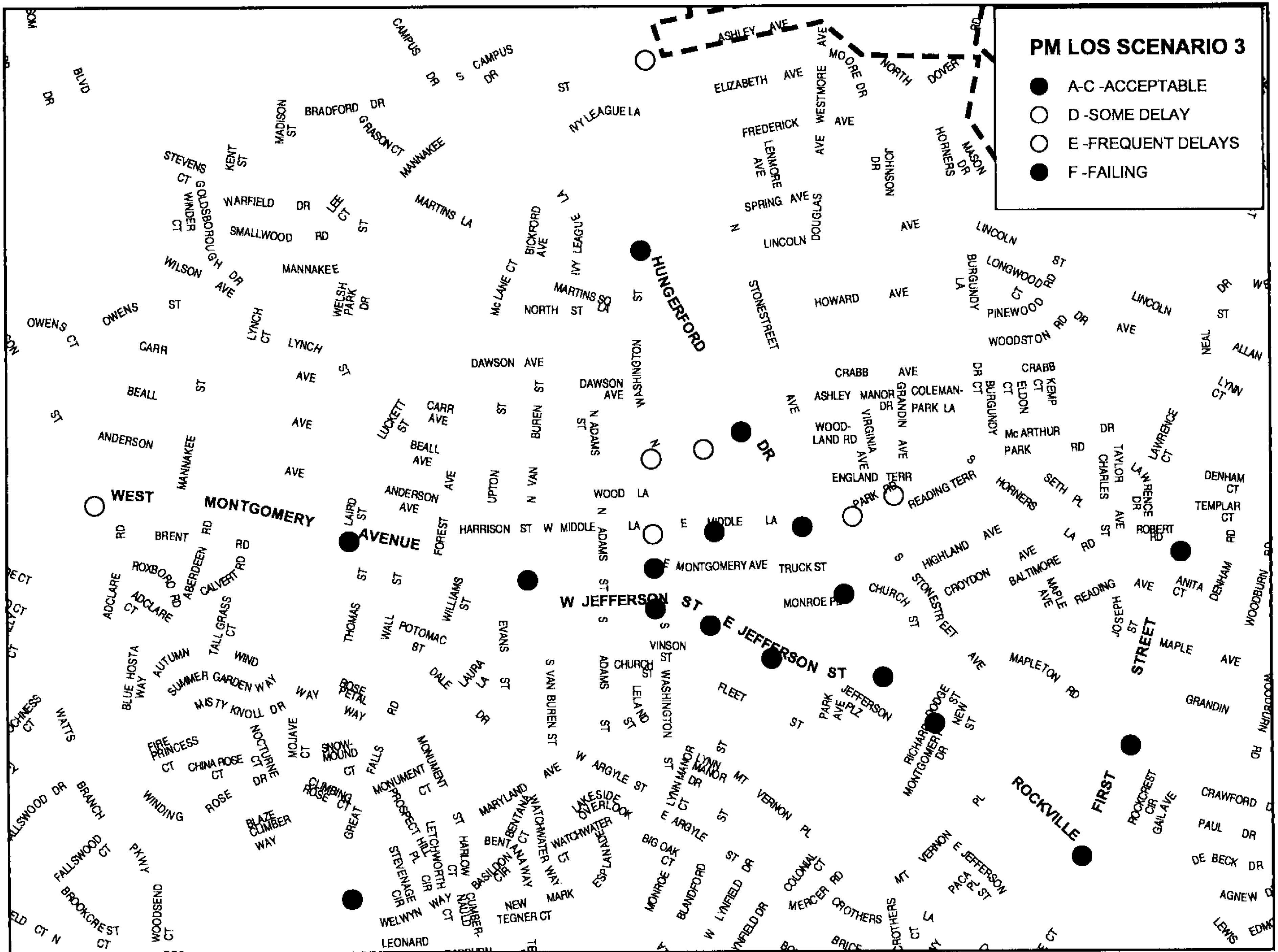

*future street alignments in darker shade

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RESULTS PER CORRIDOR

INTERSECTION - LEVEL OF SERVICE	CLV SYNCHRO NUMBER		Existing	Baseline	Scenario 1	Scenario 2	Scenario 3	Critical Movements
MD 355								
Manakee St. & MD 355	1	AM	E	F	F	F	F	SB T - OPL
		PM	C	D	E	E	E	
N. Washington & MD 355	4	AM	C	E	F	F	F	SB T+R-OPL, EB L+T+R
		PM	D	F	F	F	F	NB T+R-OPL, EB L+T+R
Beall Ave & MD 355	14	AM	B	E	F	F	F	SB T+R-OPL
		PM	A	C	F	F	F	SB T+R-OPL, WB T+R-OPL
E. Middle Ln & MD 355	20	AM	E	F	F	F	F	SB T+R-OPL, EB T-OPL
		PM	D	F	F	F	F	NB T+R-OPL OR (SB T+R-OPL), EB T-OPL
MD 355 & Church St & Monroe Pl	29	AM	C	D	F	F	F	SB T+R, EB T+R-OPL OR (WB T+R-OPL)
		PM	B	D	F	F	F	SB T+R OR (NB T-OPL), EB T+R-OPL
MD 355 & W. Jefferson & Viers Mill	37	AM	E	F	F	F	F	SB T-OPL, EB T, WB T
		PM	E	F	F	F	F	NB T-OPL, EB T
MD 355 & Richard Montgomery Dr	48	AM	B	E	E	E	F	SB L+T+R-OPL, WB T+R-OPL
		PM	A	C	E	E	F	SB T+R-OPL, WB T+R-OPL
MD 355 & First St & Wootton Pk	57	AM	E	F	F	F	F	SB T-OPL, WB T+R, EB T
		PM	E	F	F	F	F	SB T-OPL OR (NB T-OPL), EB T
MD 28								
W. Montgomery Ave. & Nelson St.	61	AM	D	C	D	D	D	
		PM	D	C	D	D	D	
W. Montgomery Av & Laird St	31	AM	E	F	F	F	F	WB T+R-OPL, SB L+T+R-OPL
		PM	E	E	F	F	F	
W. Jefferson & Great Falls Rd	32	AM	F	F	F	F	F	WB T+R-OPL, NB T+R
		PM	E	F	F	F	F	WB T+R-OPL, SB T+L-OPL
Jefferson St & Maryland Ave	35	AM	C	D	F	F	F	SB T+L-OPL, WB T+R-OPL OR (EB T+R-OPL)
		PM	C	E	F	F	F	
Jefferson St & Monroe St	36	AM	B	C	F	F	F	WB T+R-OPL OR (EB T+R-OPL), NB L+T+R
		PM	B	E	F	F	F	NB L+T+R-OPL, EB T+R-OPL OR (WB T+R-OPL)
Viers Mill Rd & First St	58	AM	D	F	F	F	F	NB T-OPL, WB T-OPL
		PM	F	F	F	F	F	EB T+R-OPL, SB T+R-OPL OR (NB T-OPL)
First St. & Baltimore Rd.	62	AM	B	D	F	E	F	WB T, SB T-OPL OR (NB T)
		PM	E	F	F	F	F	EB T+R-OPL, NB T+R-OPL
N. Washington								
N. Washington & Martins Ln	7	AM	A	A	A	A	A	
		PM	A	A	A	A	A	
Beall Ave & N. Washington	11	AM	A	B	C	C	C	
		PM	A	A	C	C	D	
W. Middle Ln & N. Washington	16	AM	A	A	C	C	D	
		PM	A	A	D	D	E	
W. Montgomery & N. Washington	24	AM	A	B	D	D	E	
		PM	A	D	F	F	F	WB L+T+R-OPL, SB T-OPL
Jefferson St & N. Washington	34	AM	B	D	F	F	F	WB T-OPL, NB T-OPL
		PM	A	C	F	F	F	WB T-OPL, SB T+R
Maryland Ave								
Falls Road & Maryland Av	42	AM	B	B	D	D	E	
		PM	B	D	F	F	F	
Maryland Av & Middle Ln	17	AM	A	C	F	F	F	EB T-OPL, NB LTR-OPL
		PM	B	D	F	F	F	EB L+T+R-OPL OR (WB L+T+R-OPL), NB T+R AND SB L+T+R
Maryland Av & Beall (Fut.)	13	AM	A	A	A	A	A	
		PM	A	A	A	A	E	
E. Middle Ln								
Park Rd & N. Stonestreet	21	AM	A	A	D	D	E	
		PM	A	A	D	D	D	
Park Rd & S. Stonestreet	22	AM	A	C	D	D	E	
		PM	A	A	D	D	D	

Intersections operatining at LOS F

Existing

1 Viers Mill & First St
2 W. Jefferson & Great Falls Rd

Baseline

3 MD 355 & Mannakee
4 MD 355 & Washington
5 MD 355 & Middle
6 MD 355 & Jefferson/Viers Mill
7 MD 355 & Wootton / First
8 W. Montgomery MD28 & Liard
9 Baltimore & First

Scenario 1

10 MD 355 & Beall
11 MD 355 & Church/Monroe
12 Jefferson MD28 & Maryland
13 Jefferson MD28 & Monroe
14 W. Montgomery & N. Washington
15 Jefferson MD28 & N. Washington
16 Maryland & Great Falls rd
17 Maryland & Middle Lane

Scenario 2

None

Scenario 3

18 MD 355 & Richard Montgomery

Intersections operatining at LOS E (in addtion to F)

Existing

3 MD 355 & Mannakee
5 MD 355 & Middle
6 MD 355 & Jefferson/Viers Mill
7 MD 355 & Wootton / First
8 W. Montgomery MD28 & Liard
9 Baltimore & First

Baseline

10 MD 355 & Beall
12 Jefferson MD28 & Maryland
13 Jefferson MD28 & Monroe
18 MD 355 & Richard Montgomery

Scenario 1

None

Scenario 2

None

Scenario 3

19 N. Washington & Midlle Ln
20 Maryland & Future Beall
21 Park & N. Stonestreet
22 Park & S. Stonestreet

1. INTRODUCTION

With the potential for further development and redevelopment, the City of Rockville, Maryland is interested in the future traffic impacts to its downtown street system. Through an existing task order contract, the City requested transportation consultant services from BMI-SG to perform a transportation study of the Rockville downtown core area. The emphasis of this study was the analyses of the traffic impacts generated by three potential future year development scenarios.

1.1 Objective of Study

The primary objective of this study was to provide information that would assist the City of Rockville in deciding upon its future downtown planning strategy. Specifically, the goal was to 1) develop future traffic projections based on three potential future development scenarios, 2) assign projected traffic onto the future study area street system, 3) analyze the potential traffic impacts associated with each scenario, 4) identify minor street improvements needed to accommodate the projected traffic demand, and 5) present the major findings and results, in terms of traffic affects, on the downtown study area street system.

1.2 Background

The City of Rockville is located northwest of Washington, D.C., along the I-270 and MD 355 (Rockville Pike/Hungerford Drive) corridors. The City occupies approximately 13 square miles, with a population of approximately 47,388 in 2000. Currently, there is very little vacant land left in the City. The City's Comprehensive Master Plan has established the growth and developments goals for the community. However, the City anticipates pressure to develop and redevelop land parcels within the downtown core area. As such, the City is concerned about the potential overloading of the downtown street system due to future development.

To make a decision about future growth, the traffic impacts on the downtown core area and on nearby residential neighborhoods must be identified, evaluated and considered. Once these impacts are considered, the overall downtown planning effort will focus on the promotion of high quality, mixed-use development with an attractive pedestrian environment and adequate traffic circulation.

The City developed three (3) specific future year scenarios to be evaluated.

The traffic impacts associated with the above described potential future year scenarios were then analyzed by BMI-SG.

1.3 Study Area

There were a total of 25 key intersections, identified by the City staff, to be analyzed as part of the study. These intersections were:

1. Route 28 and Laird Street
2. Route 28 and Great Falls Road
3. Great Falls Road and Maryland Avenue
4. Route 28 and Washington Street
5. Route 28 and Maryland Avenue
6. Route 28 and Monroe Street
7. Route 28 and Nelson Street
8. Route 28 and Rockville Pike
9. Route 28 and First Street
10. First Street and Baltimore Road
11. Rockville Pike and First Street
12. Rockville Pike and Richard Montgomery Drive
13. Rockville Pike and Church Street
14. Rockville Pike and Middle Lane
15. Rockville Pike and Mannakee Street
16. Rockville Pike and Beall Avenue
17. N. Stonestreet Avenue and Park Road
18. S. Stonestreet Avenue and Park Road
19. N. Washington Street and East Montgomery Avenue
20. N. Washington Street and Middle Lane
21. N. Washington Street and Beall Avenue
22. N. Washington Street and Martins Lane
23. N. Washington Street and Rockville Pike
24. Maryland Avenue and Middle Lane
25. Maryland Avenue and Beall Avenue

The traffic impacts associated with the network of roadways and key intersections mentioned above formed the basis of the Rockville Town Center Traffic Analysis. The key intersections are shown in Figure 1.

2. DATA ASSEMBLY

BMI-SG met with the City of Rockville staff to gather the necessary data needed to perform the downtown traffic study. Data requirements associated with land use planning, trip generation/traffic forecasting and operational analyses were discussed. Specific information provided by the City staff included:

- Turning movement count data, lane configurations, and calculated Critical Lane Voluems (CLVs) at the 25 key intersections in an Excel spreadsheet.
- Aerial photography of the study area.
- Estimates of potential build-out, in gross square footage, and type of land use for each parcel in the study area for the three potential build-out scenarios.
- Estimates, by parcel, with respect to anticipated shared public parking for new developments and redevelopments.
- A map that shows the anticipated locations for driveways and off-street parking areas for the new developments and redeveloped parcels.

As part of the data assembly, BMI-SG conducted a field reconnaissance of the study intersections. In particular, BMI-SG collected data at the two intersections not included in the Excel spreadsheet provided by the city (the intersections of Route 28 and Nelson Street and First Street and Baltimore Road). Roadway data (e.g., number of travel lanes on all streets in the network, lane use for all approaches, lengths of left turn and right turn lanes, location of all on-street parking spaces, locations of existing driveways, etc.), traffic control features (e.g., signal timings/phasing), transit information (e.g., routes and bus stop locations), site survey data (e.g., specific trip generation rates) and traffic performance were gathered and verified.

3. FUTURE CONDITIONS

3.1 Background Traffic

BMI-SG incorporated traffic forecasts that were generated by others under previous efforts. The previous traffic forecasts included the following developments:

1. Rockville Metro Plaza
2. 11 North Washington Street
3. RCI
4. 21 Church Street
5. 22 West Jefferson
6. Sandy Springs Bank
7. Richard Montgomery H.S.
8. Tower Oaks
9. KSI
10. Archstone
11. Rockville Town Center

Trips generated by these developments were then added to the turning movement counts conducted during the past five years at the key 25 intersections. This constituted the background traffic projection for each scenario.

A review of the traffic data revealed that the turning movement counts were not conducted for all intersections on the same day. It was found that traffic exiting one intersection did not approximately equal traffic entering the next intersection, resulting in unbalanced traffic flows. Using knowledge of existing land use and estimates of existing in/out site specific trips, BMI-SG identified adjustments that would need to be made to "balance" the peak hour turning movement counts at the key study area intersections. BMI balanced the existing turning movement volumes for the two peak hours of traffic.

3.2 Development Scenarios

Three future development scenarios were developed by the City staff, hereafter referred to as Scenarios 1, 2, and 3. Each scenario consists of 42 separate potential development parcels, whose locations are illustrated in Figure 2. The density or developable area varied for most of these development parcels form one scenario to the next. Development totals for each scenario are shown in Table 1 by type of development. In the table, "Proposed Development" is the amount of development or redevelopment on the 42 parcels and "Existing Development" is the amount of development that will be replaced by the proposed development. The "Additional Non-Residential" development is the difference between the proposed and existing developments. A detailed listing of the by scenario amount of development for each of the 42 development parcels is provided in Appendix A.

Table 1. Development Summary for Each Scenario

	Proposed Development							Existing Development				Additional Non-Residential	Total Res.
	Office (sq. ft.)	Retail (sq. ft.)	Indust. (sq. ft.)	Other (sq. ft.)	MF (no. of units)	SFA (no. of units)	SFD (no. of units)	Office (sq. ft.)	Retail (sq. ft.)	Indust. (sq. ft.)	Other (sq. ft.)		
1	3,064,480	680,630	114,000	424,850	2,180	333	78	295,690	248,330	308,560	38,000	3,393,380	2,591
2	2,195,490	682,860	114,000	424,850	2,514	333	38	170,410	234,340	308,560	38,000	2,665,890	2,885
3	3,287,370	703,860	114,000	229,850	3,122	489	38	295,690	248,330	308,560	38,000	3,444,500	3,649

3.3 Programmed Roadway Improvements

The following road improvements were assumed to be completed for the future year traffic analysis:

- The extension of Dawson Avenue to the east, terminating with at an intersection with MD 355 (Hungerford Drive).

- The extension of Maryland Avenue to the north, terminating at a roundabout with the future Dawson Avenue.
- The extension of Fleet Street between Mount Vernon Place and Ritchie Parkway.
- The creation of Newmarket Street, a one-way street in the northbound direction, from East Middle lane to Beall Avenue. This street will be located approximately equidistant between North Washington Street and the future Maryland Avenue (about 280 feet from either existing street).
- The creation of Renaissance Avenue, a two-lane, two-way street from East Montgomery Avenue to East Middle Lane. This street will be between Maryland Avenue and Monroe Street, across from the access to the Foulger-Pratt Rockville Metro Plaza.
- The addition of a median on Beall Avenue between North Washington Street and MD 355.

The following intersection improvements were assumed to be completed for the future year traffic analysis:

- *West Jefferson Avenue and Great Falls Road*: West approach is changed from one exclusive left turn lane, two through lanes, and an exclusive right turn lane to one exclusive left turn lane, one through lane, and a shared through and right turn lane. Construction on this change is now complete.
- *West Montgomery Avenue and Nelson Street*: East approach is changed from two through lanes and a channelized right turn to two through lanes and a shared through and right turn lane. South approach is changed from a shared through and left turn lane and a free-flow right turn lane to a shared through and left turn lane and a non-free-flow right turn lane.
- *Maryland Avenue and East Middle Street*: Intersection is changed from an unsignalized to a signalized intersection.

3.4 Traffic Projection Methodology

The projected traffic volumes for the three future scenarios were derived by adding the projected increase in trips from each development in each scenario to the background traffic. BMI-SG created Excel spreadsheets to perform trip generation and trip distribution calculations and modified the Excel spreadsheets provided by the City staff to perform traffic assignments, CLV analysis, and level of service (LOS) calculations. A detailed explanation of the functionality of these Excel files and the procedure used to obtain future year traffic projections is included in Appendix B.

3.4.1 Trip Generation

The AM and PM peak hour traffic generated from each scenario was determined using ITE trip generation rates obtained from the 7th Edition of the *ITE Trip Generation Manual*. Retail developments were assumed to consist of one-third high turnover sit-down restaurant and two-thirds retail shopping. Trips generated by developments classified as "other" were evaluated by the closest land use provided by the Trip Generation Manual and when the specific use could not be determined, trips generated were assumed to be 1 trip per 1000 square feet of floor area. Table 2 shows the equivalent land use in the Trip Generation Manual for the specified development types for this study. The number of trips generated for each scenario are shown in Table 3 and Appendix C shows the trips generated by each development parcel in each scenario.

Table 2. Trip Generation Manual Equivalent Land Use Types

Table 3. Trip Generation Totals for Each Scenario

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Scenario 1	3963	1596	5559	2394	4722	7116
Scenario 2	3528	1622	5150	2399	4280	6679
Scenario 3	4515	1933	6448	2772	5258	8030

BMI-SG then adjusted the trips generated to account for the mode share for the residential trips generated. Using the mode-choice data from the 1994 Census update and the year 2000 Census data, it was determined that the number of trips generated from the Trip Generation Manual would be reduced by 20 percent. Office trips were reduced by 15 percent.

BMI-SG then developed estimates of trip capture rates for the proposed retail for each development. Trip capture rates estimate the portion of existing trips that are captured by a proposed new development. Rates were developed using information from the *ITE Transportation and Land Development Manual* and engineering judgment and are 15 percent.

The final estimated number of peak hour trips generated for each scenario by development parcel is shown in Appendix C.

3.4.2 Trip Distribution

BMI-SG developed generalized trip distributions for the net new site generated trips (i.e., new trips = total site generated trips less captured trips). Some of the new site-generated trip productions were distributed to new site-generated attractions (i.e., I-I trips). Most of the new site-generated trip productions and attractions were distributed to external stations at the cordon line of the study area (i.e., I-X and X-I trips). A generalized distribution of these trips is shown in Figure 3. The generalized equivalent number of trips based on this distribution are included in Appendix C.

3.4.3 Traffic Assignment

Trips to/from external stations were assigned to the roadway network to planned parking garage/public-shared parking facilities identified by the City staff for each development parcel. This traffic assignment was completed for both the AM and PM peak hours for each scenario, resulting in an initial estimate of traffic through the network for the three development scenarios (called all-or-nothing assignment). These initial traffic assignment estimates were then refined based on capacity considerations at intersections to result in the final traffic projections for each scenario (called equilibrium assignment). That is, when the v/c ratio for a selected intersection was one or greater and an alternative route existed which had a v/c ratio less than one, trips were reassigned to the intersection with the lower v/c ratio.

5. TRAFFIC OPERATIONAL ANALYSES

5.1 Methodology

BMI-SG performed a traffic operational analyses of the 25 key intersections for both the AM and PM peak hours, focusing on the existing traffic conditions and the estimated traffic impacts associated with the three potential future development scenarios.

The critical lane volume method (CLV) was utilized to calculate the level of service (LOS) for the key intersections. The CLV method provides a basic assessment of whether or not capacity is likely to be exceeded given the traffic demand and intersection geometry. The procedure does not consider traffic composition or specific geometrics such as lane width, turn bay length, parking conditions, etc. Rather, the CLV method identifies critical movements at an intersection by assigning vehicles to specific lanes. Traffic is assigned to specific lanes through the use of lane use factors. These lane use factors are applied to the traffic volumes for a specific movement based on the number of lanes. The lane use factors used for this analysis are shown in Table 4.

Table 4. Lane Use Factors

Number of Lanes	Lane Use Factor
Through	
1	1
2	0.525
3	0.36
4	0.3
5	0.25
Left Turns	
1	1.1
2	0.6
3	0.38

The total critical lane volume for the intersection is determined by summing the maximum single lane volume for a particular movement for a signal phase. Two-way stop controlled intersections are assumed to have two signal phases. The total critical lane volume is then compared to the capacity of the intersection, which is a function of the cycle length and the number of phases for the traffic signal. Table 5 shows the capacity utilized for various cycle lengths and phases. The total critical lane volume divided by the capacity results in a volume to capacity ratio for the intersection, which is used to evaluate the LOS of the intersection. LOS values for different v/c ratios are presented in Table 6.

Table 5. Intersection Capacity

No. of Phases / Cycle Length	2	3	4
60	1500	1400	
90	1600	1500	1400
120	1650	1600	1500
150	1700	1650	1550

Table 6. LOS Threshold Values

v/c Ratio	LOS
0.0	A
0.6	B
0.7	C
0.8	D
0.9	E
1.0	F

The analyses also employed the use of computer traffic simulation techniques to evaluate the downtown street system. Simulation techniques provide a truer estimate of traffic performance, particularly when dealing with traffic flows and the affects of one roadway location on another. BMI-SG applied the Synchro and CORSIM computer traffic simulation models to perform these traffic operational analyses. The analyses focused on evaluating the traffic performance at the key 25 intersections in the study area as a "system", rather than evaluating each intersection independently as is the case with the CLV analysis.

CORSIM models traffic operations based on a user specified street network that details roadway geometry, lane use, traffic control devices, traffic volumes, turn movements, types of vehicles (including bus routes and stops), various driver types, etc. The simulated street network can be analyzed in two different ways. First, by comparing various simulated output measures of effectiveness (MOEs) that measure the street network's traffic performance. MOEs, such as vehicle travel time, average speed, bus travel time/delay, delay/stop time, percent stops, phase failures, queue lengths, fuel consumption, etc. can be used to make quantitative comparisons between different improvements.

A second way to analyze the simulation results is by using TRAFVU, CORSIM's graphical output software program. The program allows the user to view graphical animations of traffic flows on the representative street network. One of the primary benefits of viewing the street network with TRAFVU is that movement conflicts and areas with congestion can be easily identified and the effects of various improvements can be seen. Likewise, side-by-side windows can be used to compare one alternative to another.

In the Rockville downtown traffic analysis, both the comparison of MOEs and TRAFVU were used. Various simulation MOEs, such as queue lengths, control delay, phase failures, etc. were used to assess the traffic impacts of the existing conditions and the three development scenarios. TRAFVU was used to visually display and review the results of the simulated condition.

One of the primary MOEs from CORSIM was vehicular delay, which forms the basis for LOS. Simply put, LOS is a subjective description of traffic performance. The basis of LOS can be found in the *2000 Highway Capacity Manual (2000 HCM).* In the case of the Rockville traffic study, the evaluation of traffic performance focused along the downtown street system. The study area system was composed of arterial and collector streets, with the analyses concentrating on the 25 key signalized intersections identified by the City staff.

For signalized intersections, levels of service are evaluated based upon average vehicle delay experienced by vehicles entering an intersection. Control delay (or signal delay) includes initial deceleration delay, queue move-up time, stopped delay and final acceleration delay. In previous versions of the Highway Capacity Manual (1994 and earlier), delay included only stopped delay. As delay increases, the level of service deceases. (Note: The delay calculations for signalized and unsignalized intersections are different due to the variation in traffic control.) The levels of service associated with signalized intersections are summarized in Table 7.

Table 7. Level of Service at Signalized Intersections.

Signalized Intersections		
Level of Service (LOS)	Control Delay (seconds)	Description
A	≤ 10.0	Free Flow/Insignificant Delays
B	10.1 - 20.0	Stable Operation/Minimal Delays
C	20.1 - 35.0	Stable Operation/Acceptable Delays

D	35.1 - 55.0	Approaching Unstable/Tolerable Delays
E	55.1 - 80.0	Unstable Operation/Significant Delays
F	$\geq$ 80.0	Forced Flow/Excessive Delays

Using CORSIM, BMI-SG simulated the traffic performance along the Rockville downtown street system for the existing conditions and the three potential future development scenarios. Then, using TRAFVU, we evaluated the study network. For a given simulation condition, TRAFVU provided graphical animations of traffic performance along the representative street network, where areas of conflicts and levels congestion (i.e., queuing) could be identified.

In addition, BMI-SG compared simulated measures of effectiveness (MOEs) to quantify the traffic performance. All the MOE threshold values applied in the study were based on the values found in the *2000 Highway Capacity Manual,* with the exception of signal phase failures. A phase failure is defined as the number of times during the simulation period that a queue fails to be discharged completely during a green phase at a signalized intersection. For this study, it was assumed that any location experiencing six or more signal phase failures, during the simulated peak hour condition, was considered a problem location.

For each simulation, the MOEs were evaluated in two ways. First, the study area street system was divided into six primary travel corridors. The six primary corridors were defined as:

- Eastbound (EB) MD 28
- Westbound (WB) MD 28
- Northbound (NB) MD 355
- Southbound (SB) MD 355
- Northbound (NB) North Washington Street
- Southbound (SB) North Washington Street
- Northbound (NB) Maryland Avenue
- Southbound (SB) Maryland Avenue
- Northbound (NB) Great Falls Road
- Southbound (SB) Great Falls Road

For each of the above primary travel corridors, the overall simulated MOEs for total travel time, average speed and the corresponding level of service were estimated.

Next, specific "hot spots" or the worst problem locations were identified. These would be locations operating at a level of service "E" or worse. The specific MOE threshold values used to determine a hot spot as shown in Table 8.

Table 8. MOE Threshold Values.

Measure of Effectiveness (MOE)	Threshold Value
Arterial Streets	
Average Travel Speed	≤ 9 mph
Signalized Intersections	
Control Delay	≥ 55 sec/veh
Signal Phase Failures	≥ 6 per peak hour

5.3 Conditions Analyzed

CORSIM simulations were performed for the AM and PM peak hour traffic flows on the downtown Rockville street network. Specifically, the existing conditions and the three future developments scenarios were simulated. This resulted in three individual simulated time periods for each of the four networks, for a total of 12 different simulation conditions.